Sneezing

Causes

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Abstract

Sneezing (sternutation) usually acts to guard the airway, although it may also be a sign of several disorders. Writers have discussed sneezing since early times. The association of sneezing with superstition is common among numerous cultures and areas within Eurasia. Sneezing has often been believed to have a profound significance, showing us mysteriously what is about to happen. But from a scientific perspective, besides knowing that sneezing guards the airway, we possess little other knowledge about the phenomenon. When sneezing, an individual propels air at high pressure out of the lungs via the nasal or oral cavity, typically in response to the lining of the nose being irritated in some way. The following may each set up a sneeze: suddenly emerging into strong light, having

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eaten a great deal, physical triggers acting on the fifth cranial nerve, central nervous system disorders (e.g., epilepsy, posterior inferior cerebellar artery syndrome), or psychological conditions [1].

1 Definition

Sneezing (sternutation) usually acts to guard the airway, although it may also be a sign of several disorders. Writers have discussed sneezing since early times. The association of sneezing with superstition is common among numerous cultures and areas within Eurasia. Sneezing has often been believed to have a profound significance, showing us mysteriously what is about to happen. But from a scientific perspective, besides knowing that sneezing guards the airway, we possess little other knowledge about the phenomenon. When sneezing, an individual propels air at high pressure out of the lungs via the nasal or oral cavity, typically in response to the lining of the nose being irritated in some way. The following may each set up a sneeze: suddenly emerging into strong light, having eaten a great deal, physical triggers acting on the fifth cranial nerve, central nervous system disorders (e.g., epilepsy, posterior inferior cerebellar artery syndrome), or psychological conditions [1].

Sneezing is a reflexive action consisting of two phases. The first phase, termed the "afferent phase," is when the sensory fibers of the fifth cranial nerve become excitated and convey an impulse to the sneezing center, located laterally within the medulla oblongata. Mechanical, tactile, or chemical triggers can all lead to excitation of the afferent arm of the reflex [2, 3]. The efferent phase is then set into action: the individual draws a deep breath, followed by a highly directed, forceful expulsion of the pulmonary air through the nasal or oral cavity. Pressure is built up when the pulmonary air begins to be expelled against a closed epiglottis. When the glottis abruptly opens, this high pressure air exits the mouth or nose at a raised velocity. The actual velocity ranges between 100 and 650 mph [1, 2]. Its passage blasts dust or particles away from the surface of the mucosae lining the airway. There are a number of triggers to sneezing that have been identified, including rhinitis, physically exciting the fifth cranial nerve, disorders affecting the central nervous system, conditions that are psychological in origin, and sexual excitement [1, 4].

The initial description of the "autosomal dominant compelling helio-ophthalmic outburst" (ACHOO) or "photic sneezing reflex," a particular type of sneeze, is owed to Sedan [5]. This type of sneezing is triggered in susceptible individuals when they find themselves faced with high-intensity light, notably sunshine or the light used in ophthalmoscopy [5, 6]. Several studies have investigated how commonly this phenomenon occurs, coming up with estimates ranging between 17% and 35% [7–9]. One caveat here is that the sample sizes employed were relatively limited, comprising less than 460 individuals.

2 Pathophysiology

The sternutation reflex consists of two discrete phases. The afferent (aka nasal or sensory) phase is initiated when the nasal lining is irritated either chemically or physically. The fifth cranial nerve has multiple terminal branches going to the skin over the face. These convey sensation of touch, pain, and temperature. There are also branches terminating in the lining of the nose [2]. The fibers involved are small caliber, with a myelin sheath, and ending in a sensory receptor. The receptors are of several types, with the ability to detect chemical substances, touch, and movement [2]. The afferent fibers convey signals to the fifth cranial nerve ganglion via several distinct branches (anterior ethmoidal, posterior nasal, infraorbital, and ophthalmic) [10]. The signals are then passed onto the sternutatory center located laterally in the medulla oblongata [3]. The center sums the inputs, and once a threshold is exceeded, the second phase of sneezing begins with recruitment of appropriate neurones controlling the various muscles of respiration [11]. The afferent phase involves closure of the eyes, a deep inward breath, closure of the glottis, and, at first, forcible expulsion against the closed glottis. The pressure in the lungs rises, and once the epiglottis snaps open, there is a release of air through the nasal and oral cavities which has an explosive character. The fast-moving air sweeps away dust and other particles residing on the mucosae of the airways.

Everett took two different approaches in seeking to account for how exposure to intense light brings on sneezing [8]. His initial approach was to explain the reflex as a parasympathetically mediated response, whereby light triggered increased secretory activity by the nose. The endings of the fifth cranial nerves then respond to this extra mucus by triggering sneezing. Everett then went on to postulate that the optic nerve and tigeminal nerves were both involved in a chain of events leading to sternutation. There are both sensory and motor divisions within the fifth cranial nerve. Sensory afferent fibers, contained within the ophthalmic, maxillary, and mandibular branches of the trigeminal, supply sensation from the nasal and oral cavities and the skin of the face. The highest branching division of the fifth cranial nerve is the ophthalmic branch. It is also the most diminutive. The ophthalmic nerve divides into two, one branch supplying the nose and forehead, while the other goes to the orbit, and much of the eye itself, including the cornea. The nasal interior is innervated by the anterior ethmoidal nerve, which also innervates the superior sinuses and the superior nasal septal region. These branches supply impulses to the trigeminal ganglion [10]. Everett's theory is controversial. Langer et al. disputed whether sneezing in response to intense light was a reflex in the proper sense. These researchers noted that intense light stimulated multiple areas of the brain, including the visual and somatosensory cortex. They used electroencephalography to draw this conclusion [12].

3 Aetiology

The aetiological factors behind sneezing are as follows: [1].

- Rhinitis
- Photic sneeze reflex (ACHOO syndrome)
- Physical stimulation to the fifth cranial nerve
- Disorders of the central nervous system
- Psychological factors causing intractable sneezing
- "Snatiation" reflex (i.e., following a large meal)
- Sexual thoughts or orgasm

Rhinitis refers to inflammation of the lining of the nose. It produces the following symptoms: feeling stuffy, nasal discharge, nose itch, and sternutation [13].

3.1 Allergic Rhinitis

Allergic rhinitis (AR) is inflammation of the internal nasal mucosa arising as a result of type 1 hypersensitivity to an allergen, mediated through immunoglobulin E (IgE) [13]. Pruritus and sternutation are among the most troubling symptoms in AR, alongside a blocked nose and nasal discharge. Rhinitis of allergic type has been shown to be associated with release of substance P, a neurotransmitter found in C-fibers [14, 15]. When nasal lavage fluid was compared between those suffering from AR and healthy controls, substance P levels were found elevated in the former group. This implies that the condition is associated with greater activity of the sensory fibers of the nervous system [16]. When extraneous substance P was administered to patients without any symptoms of AR, symptoms then developed, despite an absence of markers of inflammation. The symptomatic occurrence was dose-dependent. AR is characterized by hyper-reactivity of the nose, linked to the production of signaling molecules involved in allergy, e.g., the eicosanoids, certain cytokines (interleukin 6, interleukin 1b, TNF-alpha), and in particular certain neurotrophins, among which nerve growth factor and brain-derived neurotrophic factor are notable. Nerve growth factor acts on pain-receptor bearing neurones, causing increased activity, production of substance P, and the formation of dendritic extensions [17]. This increase in brain-derived neurotrophic factor within the mucosal cells of the nose corresponds closely to greater symptom scores in individuals suffering from AR [18].

3.2 Infectious Rhinitis

The most commonly involved viral pathogen in nasopharyngitis producing coryza, accounting for above half of cases, is rhinovirus. The virus may be transmitted by breathing in the virus, being close to an infected individual or touching virally contaminated surfaces, e.g., door handles, school desks, items around the home, or telephones. The most frequently seen initial symptoms are high pyrexia, having irritation within the nose and sternutation [1].

Non-allergic rhinitis with eosinophilia syndrome (NARES) involves hypersensitivity of the nose, producing symptoms of sneezing fits, rhinorrhea, nasal congestion, and reduced ability to smell. Eosinophils account for more than 20% of the total white cell count, but there is no evidence of an allergic response occurring through an IgE-linked mechanism [18]. It is thought that the condition arises when eosinophils migrate to a source of inflammation within the nose, attracted by high levels of substance P. The elevated substance P may come about due to an irritant, through age-related factors or for other, unknown reasons [1].

4 Photic Sneeze Reflex

The photic sneeze reflex appears to be a genuine phenomenon, whereby certain individuals exposed to intense light, e.g., sunlight, begin to sneeze. This phenomenon has also been referred to as the ACHOO (autosomal dominant compelling helio-ophthalmic outburst) syndrome [6]. Sedan was the first writer to note the existence of the phenomenon [5]. The tendency appears to be inherited in an autosomal dominant fashion. It apparently affects 17–35% of people globally [7]. Reports suggest a prevalence of ACHOO in 23% of students studying medicine [8]. A study of the prevalence among individuals donating blood returned a value of 24% [9].

The syndrome may be of concern in those whose work involves transportation and where they may suddenly be exposed to bright sunlight. Clearly, a sneezing attack could be highly dangerous in an individual responsible for a vehicle travelling at high speed. Research into the mechanism producing the sneeze is needed if potential preventative strategies are to be developed. To date, however, such mechanisms have not been discovered. Studies may suffer from irreproducibility. Research by Langer et al. has identified that the phenomenon involves multiple cortical somatosensory areas, not merely a brainstem reflex [12]. It is possible that there are other ways to trigger sneezing than have so far been utilized in experimental studies. Thus the true prevalence may be even harder to quantify than is currently thought to be the case [4].

5 Clinical Significance

Sternutation is one of the symptoms of AR. Other symptoms that may occur are pruritus (nasal, ocular, otic, palatal), nasal discharge, postnasal drip, nasal blockage, impairment of ability to smell, cephalgia, otalgia, excessive lacrimation, ocular erythema, ocular edema, fatigue, drowsiness, and malaise [19].

A precise patient account is key to assessment in AR. The history should encompass the type, length of, and temporal pattern of symptoms, triggering factors, response to pharmacotherapy, other medical history, any familial tendency to atopy, environmental and job-related hazards, and impact on life quality. A detailed and exhaustive history can narrow down the search for triggering allergens where present [20].

Viruses have evolved to be able to trigger a sneezing response, since this is one way in which a pathogen (notably rhinovirus) can be rapidly dispersed over long distances and encounter suitable new hosts in which to reproduce [21, 22].

Animal experiments have been conducted in felines to discover the ways in which sneezing can be induced. For example, electrical nerve stimulation has been applied to the anterior ethmoidal nerve [11], and mechanical stimulus or puffs of air have also been employed [23]. A vibrator and electrical stimulation have been applied to the pontomedullary region of the brainstem where it is thought the trigeminal nucleus and tract are located [24]. Patients with Wallenberg's syndrome (which affects the lateral medulla) may be unable to sneeze, which appears to be evidence for a sternutatory center in the lateral medulla in man [25].

By reducing the frequency of sneezing, it may be possible to lower the rate of viral transmission. However, more research is needed to refine the neuroanatomical understanding of sneeze-related nervous tissue within the nose. A pharmacological agent capable of suppressing the sneeze response without incurring an unacceptable burden of side effects has yet to be discovered. When and if such an agent exists, it might usefully be included in intranasal inhalers for use in upper respiratory tract infections. Research will also be needed to assess what complications might arise in individuals if they are rendered incapable of sternutation [4].

6 Conclusion

Sneezing is a protective reflex to expel mucus and its trapped particles or virulent organisms from the upper nasal airways. It has various triggers listed above and involves facial, pharyngeal, diaphragm, chest, and abdominal muscles to work together in tandem to produce a successful sneeze. Though it can be troublesome, it is rarely a sign of a serious medical condition. Overall sneezing has evolutionary roles in protecting the individual and keeping one healthy.

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